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DIVISION OF MINES AND GEOLOGY
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March 12, 1998

Mr. Harry Pritchard
Board Chairman
Weott Community Services District
P.O. Box 130
Weott, CA 95571

RE: Preliminary Engineering Geologic Evaluation of Access Road Damage Weott Community Services District, Weott, Humboldt County, California

Dear Mr. Pritchard:

INTRODUCTION

On February 23, 1998, Battalion Chief Kevin O'Neill of the California Department of Forestry and Fire Protection (CDF) requested the Department of Conservation's Division of Mines and Geology (DMG) to perform a preliminary engineering geologic evaluation of a small rotational slump and a reactivated landslide that were affecting access roads to Weott's sewer treatment facility (Site A, Figure 1) and a domestic water supply tank (Site B, Figure 1). This request was initiated by Harry Pritchard, Board Chairman of the Weott Community Services District and came through Neal O'Haire of the Governor's Office of Emergency Services (OES) under OES Mission Number #98-CST7252. The slump at Site A originally occurred approximately 1 week prior to this review. The roadway was repaired at that time but the slump reactivated recently.

Weott is located approximately 30 miles southeast of Eureka on U.S. Highway 101 in Humboldt County, California (Section 2, T2S/R2E, HBM, Weott 7.5 minute quadrangle). The District's main concern was restricted access for maintenance and repairs to their facilities. Longer-term mitigations will be designed by their consulting engineer once the weather improves. This report presents the observations, conclusions, and recommendations of DMG Associate Engineering Geologist James Falls regarding short-term mitigations of the slump and reactivated landslide and general long-term mitigation concepts. DMG's work is to aid in providing protection for lives, property, and public infrastructure.

FIELD WORK

On February 23, 1998, Falls, District Board Chairman, Pritchard and CDF representative Bill Cristen conducted a field reconnaissance to assess the scope and activity level of the two sites. DMG developed sketch maps of the two features during the reconnaissance (see Figures 2 and 3).

LOCAL GEOLOGY

The bedrock in the region is mapped as interbedded, well-consolidated silty shale, siltstone, sandstone, mudstone and conglomerate of the Yager Formation (Spittler, 1983). The shale and mudstone disaggregate by slaking (break into many small pieces) when wetted and exposed to air. Bedding orientation data are sparse, but field observations by DMG approximately 1/2 mile to the northeast suggest that the Yager Formation dips very steeply to the northeast in this area.

An old river terrace (Qrt) is mapped under most of the town (see Figure 1). The terrace was eroded by the Eel River thousands of years ago and was raised to its present level by regional uplift. The river has continued to cut down into the bedrock and has left this, and other terraces like it, stranded on the adjacent hillsides.

Site A. Intact, deeply weathered mudstone (Yager Formation bedrock) capped by 6 to 10 feet of sandy, cobbly gravel (old river terrace deposits) was observed in the crown scarp of the rotational slump and in a nearby road cut. Abundant ground water was perching on the bedrock and exiting at the contact with the overlying terrace deposits.

Site B. The materials exposed at Site B appeared to consist of deeply weathered, small, blocky fragments of siltstone and shale. This material is associated with a reactivated landslide complex underlain by the Yager Formation (see Figure 1). The District representative indicated that the slide moved during the heavy rains of 1964 and again during the 1992 Cape Mendocino earthquake sequence.

GENERAL OBSERVATIONS

The following observations are keyed to Figure 1, Site Location Map; and Figures 2 and 3, Site Maps A and B.

Site A. A rotational slump has occurred on the treatment plant access road near a crossing on an unnamed ephemeral drainage (see Figure 2). This road also provides access to a residence near the plant. The slump is approximately 50 to 55 feet wide, 80 to 90 feet long, and 15 to 20 feet deep. The existing road has been offset approximately 5 to 6 feet laterally and 2 feet vertically. A small older rotational slump is present next to the creek below the road at the northern boundary of the slump (see Figure 2).

The access road crosses near the center of the new slump using cut and fill construction, and may have inadvertently made the slope more susceptible to failure. The older slump feature below the road may have been caused by creek erosion undercutting the toe of the slope. This could also have occurred in the case of the recent failure, but it was not obvious because dense slash and woody debris were present in the channel at the toe of the slump.

The roadway was most recently repaired (approximately one week prior to this site visit) by placing compacted gravel fill on the dropped section to bring it back up to grade. This probably added more driving force to the slump, aiding its reactivation after the initial movement. Two 12-inch diameter plastic pipes have been added to the inside ditch at the lateral margins of the slide to improve drainage on the dropped section. These were functioning during the site visit.

An existing 30-inch diameter corrugated metal culvert is in place at the inlet of the watercourse crossing and appears to have been installed when the inlet armoring concrete was placed. The remainder uses sections of pre-cast concrete culvert. Most of these have settled out of alignment and water appears to be flowing through the gaps.

The crossing was overtopped during the recent storms. However, the roadway pavement and armoring of the inlet and outlet has worked very well, allowing only minor erosion at the crossing. The District wishes to keep the existing pipe in place.

<u>Site B</u>. The second feature is located above town along a road to the District water tank (see Figure 1). The road also provides access to numerous residences. Many of the houses are heated by tanked propane which must be delivered by truck. The road crosses an old slide complex, a portion of which has been reactivated (see Figure 3). The larger slide reflects several periods of rotational slumping along with earthflow activity below the road.

The old landslide is approximately 170 feet wide, 500 to 600 feet long, and probably 50 to 80 feet deep. The active portion appears to have two sections (see Figure 3). The northern part is approximately 30 feet wide, 60 to 80 feet long and 10 to 15 feet deep. The roadway has dropped 3 to 5 feet here. A ramp was under construction leading down into the dropped section. The southern section has been largely modified by grading. It appears to continue along the roadway approximately 100 feet and the road appears to have dropped 1 to 3 feet. Only minor offset was present at the southern lateral margin. Abundant ground water was flowing out of the road cut within the active portions of the slide.

A second small landslide was noted along the outer edge of the access road approximately 100 feet north of the recent sliding. The slide is on the far side of a resistant ridge and is approximately 40 feet wide, 10 to 15 feet deep, and 50 to 60 feet long. There is a 5 foot drop down to the unit surface of this slide. An 18-inch diameter corrugated metal culvert discharges onto a rip-rap energy dissipator at the head of a small gully adjacent to the small slide, but recent high flows in the channel appear to have eroded the toe of the slope. Additional movement can be expected as the toe continues to be eroded.

CONCLUSIONS

Both of the sites appear to have been strongly influenced by periods of heavy rainfall creating locally high ground water levels. Abundant ground water was observed exiting near the heads of both features during the site visit. Overland runoff did not appear to be a significant contributor.

Site A. The recent slide did not appear to be a reactivated landslide. The access road appeared to have been built using a combination of cut and fill. This may have altered slope equilibrium and made the slope more susceptible to failure during wet weather.

Site B. The orientation and drainage of the roadway appears to be appropriate given the site conditions. The slide appears to have been moving for a long period of time, and the roadway itself probably has had little effect on the long-term behavior of the slide.

Immediate Mitigations.

Site A. New fill should not be placed on the sunken section of roadway as before. Any fill placed on this portion of the slump will add driving force, placing it closer to the conditions required for renewed movement. Instead, the dropped section of the roadway can be used as the new running surface. Ramps should be excavated outward in both directions from the dropped section up to the level of the existing road.

Road runoff should be intercepted before it is able to drain onto the section of the road crossing the slide. The section of roadway on the slide should be dipped and outsloped so it will naturally drain and will not collect water.

Site A Watercourse Crossing. The pipe under the road appears to be in poor condition and can be expected to fail in the near future. The existing pipe should be removed and upgraded to a larger diameter continuous pipe.

If the same pipe diameter must be used, the inlet should be mitered to improve the flow capacity. A vertical stand pipe may also be added near the inlet in order to act as an air siphon. This will also help increase the flow capacity even when the inlet is completely submerged.

Site B. The current grading appears to be the only viable alternative at this location until better weather prevails and the slide can be carefully evaluated. Adding fill to make a ramp down onto the slide is normally not the preferred solution, but excavating a ramp up out of the slide as recommended at Site A would make the resultant roadway too steep for conventional vehicular traffic.

PUBLIC SAFETY

There did not appear to be an immediate threat to public safety at either site. However, the roadway condition should be regularly monitored and vehicular traffic should be controlled or prohibited as needed. This is particularly the case with propane tanker deliveries.

RECOMMENDATIONS

Site A. Several long-term solutions should be evaluated once the weather has improved and the site is stable. These concepts should be evaluated and designed by a licensed Civil Engineer working with a certified Engineering Geologist prior to any construction.

1. Light Weight Fill. Remove the section of the slump directly under the roadway footprint and replace it with a light weight fill. In this way, a significant portion of the slump will be removed, greatly lessening the driving force in the feature.

2. Such a fill should extend down to bedrock and be constructed using wood chips, sawdust, or other “hog fuel”. It is critical that the new fill be kept dry and well-drained, otherwise it will decay and settle excessively. This can be accomplished using a french drain. When installed properly, such repairs can last many decades. References can be provided as needed.

3. Engineered Fill. Remove/recompact the slide mass as a compacted engineered fill with appropriate subdrainage. Armor the toe of the new structure against creek erosion.

4. Retaining Wall. Leave slump in place. Install a french drain along uphill side of road. The french drain should extend to bedrock in order to intercept ground water. Design a structure to retain the toe.

Site B. This site will probably never be fully mitigatable given the extent of the slide and the District’s limited resources. However several limited mitigation concepts are presented for consideration. As before, these concepts should be evaluated by a licensed Civil Engineer working with a certified Engineering Geologist.

1. Subsurface Drainage System. This should be considered as a means of slowing the slides’ rate of movement by removing water from the old slide mass. The roadway could then be repaired and regraded as needed. It should be noted that slow movement of the slide will eventually damage the drainage system to the point where it will stop functioning. Accelerated movement could recur. Periodic reinstallation of the drainage system should be expected in order to maintain the effectiveness of this concept.

2. Subsurface Drainage System and Roadway Realignment. A broad bench in the slide mass is located uphill of the current roadway and could be used as a new alignment. The road could then be continued farther to the south by excavating a through-cut in the stable ridgeline and connecting it with an existing driveway on the far side. A subsurface drainage system should be installed to remove ground water and improve the stability of the slide mass. The old roadway should be abandoned and regraded to make it impassable to traffic. This will improve the surface drainage in this part of the slide. It is important to note that this concept does not take into account the numerous ownerships the new road would have to cross.

Small Slide. The small slide north of the main road problem will probably continue to propagate upslope into the road unless the toe is armored against continued gully erosion. This will probably require an additional 50 to 70 feet of rock armoring in the channel. The District should also consider installing an additional culvert uphill from this one as a means of reducing the amount of runoff delivered to this drainage.

References:

Spittler, T.E., 1983, Geology and Geomorphic Features Related to Landsliding, Weott 7.5' quadrangle: California Division of Mines and Geology Open File Report OFR 83-6 S.F., scale 1:24,000.

U.S. Department of Agriculture, Agricultural Adjustment Agency, 1942, black and white photographs, frames CVL-11B-107 and 108, nominal scale 1:24,000 dated March 3, 1942.

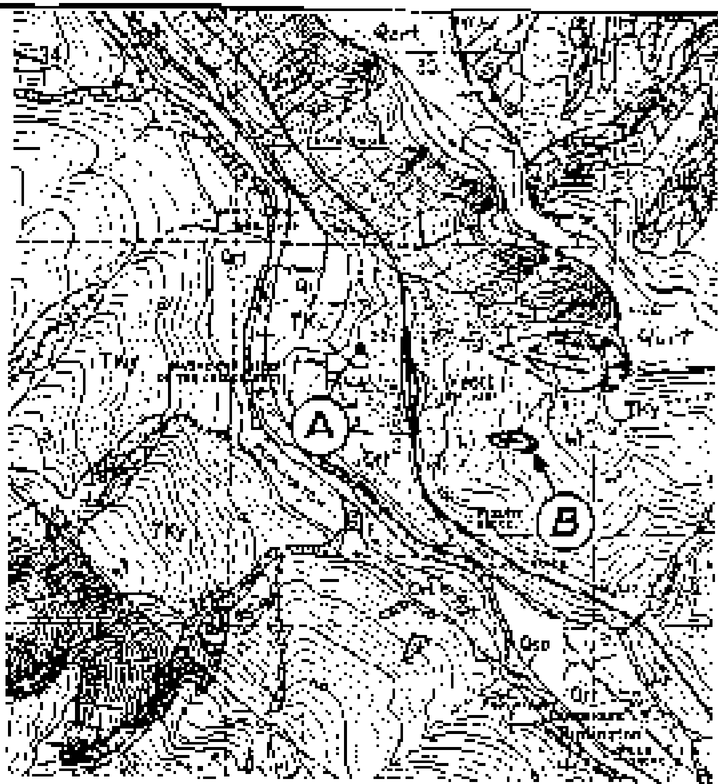
James N. Falls, CEG 1696
Associate Engineering Geologist

Concur:

Date Trinda L. Bedrossian, CEG 1064
Supervising Geologist

Attachments

cc: Bill Cristen, CDF
Kevin O'Neil, CDF
Neal O'Haire, OES
James Davis, DMG



A location referenced in text

Qrt RIVER TERRACE DEPOSITS
Qort OLDER RIVER TERRACE DEPOSITS
TKy YAGER FORMATION

debris slide
debris slide amphitheater
debris slide slope
rotational landslide
debris flow scar
small landslide

N

Base: Spittler, 1983, Geol. and Geomorph. Features Related to Landsliding, Weott 7.5 min. Quad.

Date: 3/12/98

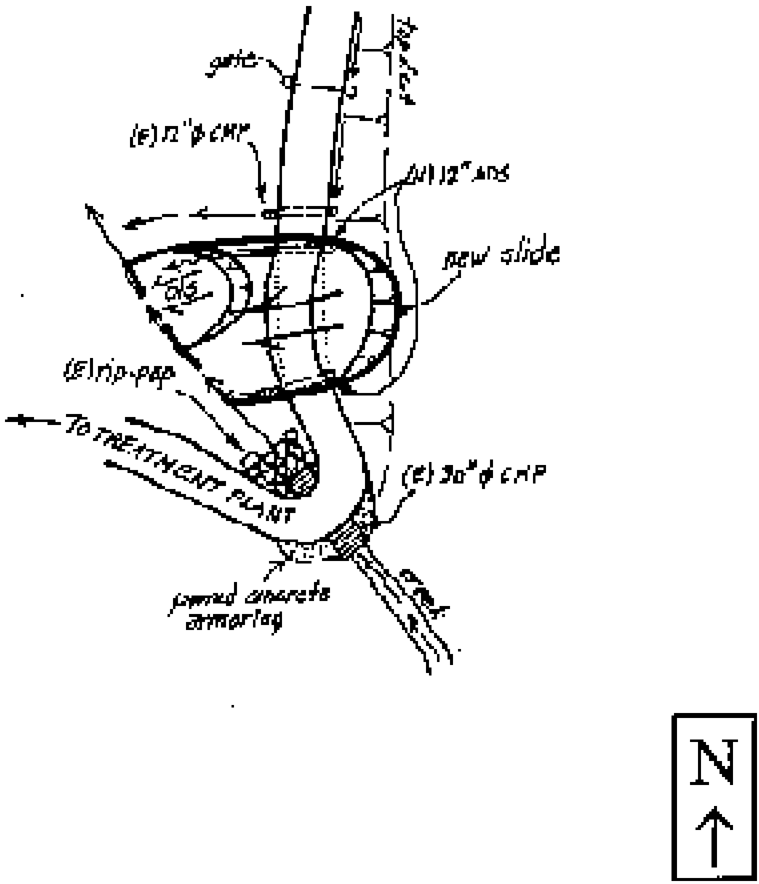
Scale: 1"=2,000'

Approved By:

CDMG

Regional Geologic Map
To Accompany
Engineering Geologic Review of
Recent Landslides in the
Weott Community Services District

Figure 1

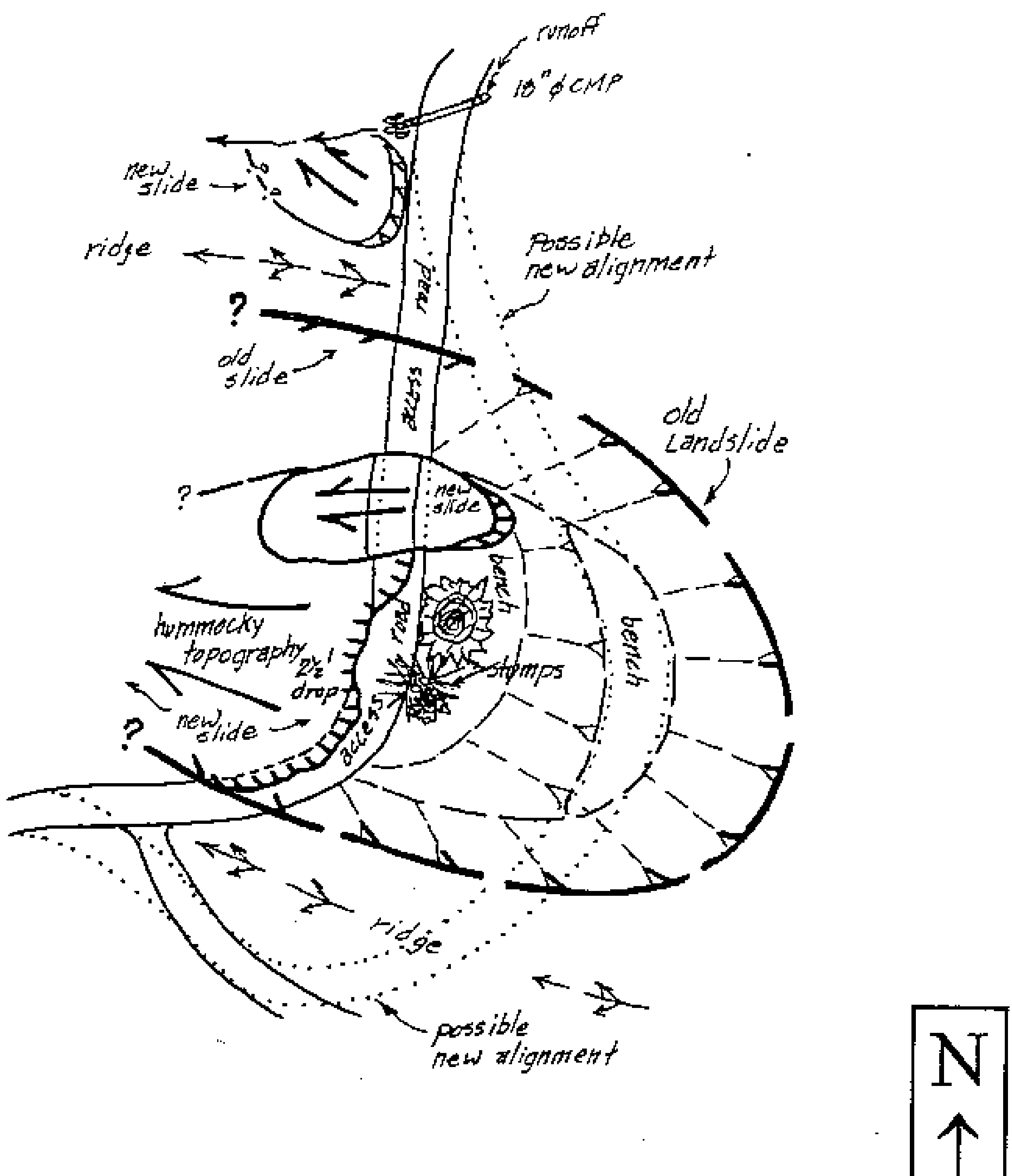


Base: site sketch by J.N Falls, CDMG. 1998

Date: 3/12/98	**Site Map A**
Scale: none	To Accompany
Approved By	Engineering Geologic Review of
CDMG	Recent Landslides in the
	Weott Community Services District

Figure

2



Base: site sketch by J.N.Falls, CDMG, 1998

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cale: none	To Accompany	**Figure**
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CDMG	Recent Landslides in the	
	Weott Community Services District	3